George C. Marshall Space Flight Center
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QD-M-001
REVISION D
Effective Date: October 15, 2004

ORGANIZATIONAL INSTRUCTION

MAINTAINABILITY REQUIREMENTS DEFINITION

OPR(s)	OPR DESIGNEE
QD10, QD20, QD30,QD40	Prince Kalia

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VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		11/19/97	
Revision	A	7/1/99	Changes made to reflect new organization code changes and/or changes made to reflect new directives renumbering scheme.
Administrative	N/A	8/28/00	OPR and/or OPR Designee change due to personnel transfer or other administrative reason. No other change to the document has been made.
Revision	B	09/04/02	Format and numbering change to implement requirements of QS-A-001 rev F.
Revision	C	10/20/03	Revised to expand and clarify Instructions section
Revision	D	10/15/04	Updated OI to implement HQ Rules Review in accordance with CAITS Action # 04-DA-01-0387) (Utilizing the word "Shall" for all requirements, removing ambiguity, removing non-requirements, etc.)

Maintainability Requirements Definition

1. PURPOSE, SCOPE, APPLICABILITY

1.1 Purpose

The purpose of this Organizational Instruction (OI) is to establish the process that shall be used for Maintainability Requirements Definition (MRD) for MSFC programs and projects. MRD is the process performed to translate program/project maintainability goals, objectives and/or requirements into appropriate quantitative and qualitative maintainability design criteria to influence the system design.

1.2 Scope

This OI describes the S&MA responsibility that shall be performed for flight hardware/software for Maintainability Requirement Definition. MRD is necessary to establish and allocate the quantitative and qualitative maintainability criteria necessary to achieve program/project maintainability goals or requirements within the given operational constraints.

1.3 Applicability

This OI is applicable to all S&MA personnel supporting MSFC programs and projects that require or specify maintainability requirements.

2. DOCUMENTS (Applicable and/or Reference)

2.1 Applicable Documents

NPD 8720.1	NASA Reliability and Maintainability (R&M) Program Policy
MPD 8720.1	MSFC Reliability and Maintainability Program for Space Systems
NASA-STD-8729.1	Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program

2.2 Reference Documents

QD-M-003	Maintainability Allocation

MKIT	Maintainability Toolkit: A Practical Guide for Designing and Developing Maintainable Products and Systems, published by the Reliability Analysis Center
MPG	Maintenance Planning Guide – Air Force Aeronautical Systems Center – 1 Nov 2001

3. DEFINITIONS

All definitions applicable to this OI are addressed in NASA-STD-8729.1

4. INSTRUCTIONS

4.1 Maintainability Requirements Definition

Maintainability requirements are typically derived from program/project user needs and objectives. Contractual instruments, such as system and equipment specifications, shall be used to translate the high-level user needs and objectives into specific qualitative and quantitative maintainability design criteria that are used to influence the system design for maintainability. These design criteria need to be communicated to the designers through the maintainability engineers, who shall be established members of the design team. This interaction is key in creating an effective maintainability program. Additionally, the Maintainability team shall work closely with the Supportability team to ensure that the maintainability concept can fit within the supportability framework and that all assumptions and guidelines match between the two efforts.

Maintainability requirements definition shall be initiated early in the project formulation phase of the acquisition process. The first step in performing an MRD is to identify the high-level user needs and objectives relating to maintainability. In some cases, the user need may be expressed in terms of a quantitative goal or requirement, such as Operational Availability or Mean Maintenance Crewtime. In other cases, the user need may be expressed in qualitative terms, such as reduced turnaround time between flights of a reusable vehicle. In both cases, appropriate quantitative and qualitative maintainability design requirements shall be derived from the user needs and established for the overall system. Assumptions and groundrules shall be documented throughout each phase of the maintainability effort. Additionally, a maintenance strategy of either two or three

levels shall be established early, to help guide the maintainability planning that will occur throughout the life of the project.

Once system level quantitative maintainability requirements have been established, they are be decomposed and allocated down to the level needed to be meaningful to the equipment designers. While an Operational Availability or Mean Maintenance Crewtime Requirement may be appropriate at the system level, these requirements do not fully provide the required detail to an equipment designer. At the equipment level, maintainability is typically specified in terms of Mean Time To Repair (MTTR) and/or Maximum Time To Repair (M_{max}). Refer to OI QS-M-003 for further definition of the quantitative maintainability allocation process.

Qualitative maintainability requirements are used to influence the equipment design for maintainability by requiring incorporation of design features that are known to result in an optimized maintenance configuration, but which generally cannot be quantified. These are typically not hard requirements, but good engineering design practices that will result in reduced maintenance time. Examples of qualitative maintainability requirements include locating components based on expected failure rates, use of captive fasteners on replaceable items, color-coding of wiring and/or plumbing lines to aid identification, and use of standard tools. Appendix A of Reference Document (2) provides a comprehensive listing of qualitative maintainability design guidelines that can be tailored for use on MSFC programs and projects.

The maintainability requirements established for a program/ project shall be tailored to the unique features and needs of that program/project. The derived maintainability requirements shall be comprehensive enough to address the needs of the system and shall be fully integrated into the systems engineering process.

5. NOTES

None

6. SAFETY PRECAUTIONS AND WARNING NOTES

None.

7. APPENDICES, DATA, REPORTS, AND FORMS

Information required for performing the MRD shall be obtained from user needs and objectives, program/project plans, design engineers, engineering drawings, project specifications, and other applicable project documentation.

8. QUALITY RECORDS

None.

9. TOOLS, EQUIPMENT, AND MATERIALS

The user shall define any tools, special equipment, or materials used during maintainability requirements definition.

10. PERSONNEL TRAINING AND CERTIFICATION

R&M Training will include maintainability requirements definition.

11. FLOW DIAGRAMS

None